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## Implementing Active Learning Strategies: Tales from Two New Life Science Professors at Research Universities

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# Academic Leadership Journal

## Introduction

Past research examining the effects of lectures on student learning suggests that they limit interactions in the classroom, place the responsibility for learning solely with the instructor, and do not provide an environment that compliments a range of learning styles (Silverthorn 1998; Landis et al. 1998; Aboudan 2009). Fortunately, there are many different active learning techniques such as role playing and group activities to more directly engage students and develop their ability to synthesize information, communicate clearly, and adapt to changing knowledge (e.g. Mason 2005; Colley 2008; Cornelius-White 2007). In this paper, we share our experiences implementing active learning practices in our science classes at Michigan State University (a 300-level Soil Biology class with ~30 students) and at the University of Colorado (200-level Plants and Society course and 400-level Public Lands and Ecosystem Management course with ~25 students). Our faculty positions are predominantly in research and we had little prior training in teaching at the undergraduate level before obtaining our tenure track positions but we share a strong commitment to student-led and active learning models of teaching.

We report on the implementation of a range of classroom activities that have been widely advocated in the literature and yet remain less common in the sciences than other disciplines. The practices we use include: 1) seminars, in which students take a lead in discussion of course content; 2) role-playing activities whereby students take on the role of a different person and creatively explore how their perspectives may change; and 3) oral and written self evaluations.

## Seminars

Seminars are in-class discussions which can be moderated by either a faculty member or students. It is well established that seminars and group discussion activities lead to a better understanding of concepts presented in class and enhance participatory learning (Lake 2001; Brookfield and Preskill 2005). We have implemented seminars as a central learning tool in both lower and upper division science courses with up to 33 students. Typically, we devote about half our classroom time to seminars. We divide classes with more than 20 students into smaller seminar groups of 5-7 participants at the beginning of the term. The smaller group is less intimidating for those who have fears of public speaking and gives all students the opportunity to contribute (Johnson 1992). We structure most seminars around questions that facilitate conversation and knowledge application. The first couple questions are intended to give students an opportunity to recall lecture content, while the rest encourage the application of that knowledge to other fields and global issues.

Clearly, not all students are equally comfortable with public speaking and an important part of facilitating seminars is to give everyone the opportunity to contribute. We use several strategies to get everyone participating in group discussions. On the first day of class we ask one question that everyone (including the instructor) responds to in a large group with all class participants involved.

Examples of these questions are: 1) tell us one interesting thing about yourself; 2) describe your most positive academic experience; and 3) tell us the weirdest thing about yourself. For those students who are nervous, we have opted to make this first question centered more on trust building as opposed to exploring academic content. This first day question has quickly become a favorite activity for us due to the surprising responses that are often quite revealing of the lives of our students. For example, when students were asked to discuss “the weirdest thing about yourself,” it was not uncommon for students to discuss the daily challenges they face with disabilities such as obsessive compulsive disorder (OCD) and attention deficit hyperactivity-disorder (ADHD). The goal in these first few classes is to create a “safe space” for students that are intimidated by public speaking.

## Role Playing

The overarching goals in classroom role playing activities are to have students gain experience in creating an argument and using evidence to defend their arguments. Role playing activities differ from seminars in that different viewpoints are artificially created and students are asked to present the issue from the perspective of a person that comes from a different background, either educational, cultural, or economic. Role playing has been frequently used in history courses but much less in the sciences (McDaniel 2000; Morris 2003). We have most successfully used role playing in courses that explore controversial issues where science and society intersect, and often conflict, including climate change and engineering of genetically modified organisms.

Role playing was recently used in an upper division ecosystem and public lands management course at the University of Colorado. During the first week of the course a hypothetical ecosystem was created, with specific physical and biological features, a unique land use and cultural history, and recent changes in demographic patterns that were creating disagreements amongst different stakeholders. The students were told that a coalition of representatives from all the stakeholder groups was being formed to resolve these disagreements with the hope to more effectively make land management decisions. Each student was then randomly assigned to represent a different stakeholder group. A few examples of the roles played by students were: a real estate developer, a rancher, a forester, a mayor of the town, and a member of the local Native American tribe. The students were asked to write a realistic “biography” of the person they would be representing. Biographies gave students the opportunity to create a unique voice and each one was read to the class during the second week. Throughout the term, issues such as dam removal to restore free flowing rivers, endangered species conservation, and climate change were presented to the stakeholder group for discussion. The end result was an opportunity to see that effective decision making not only involves good science, but inclusion of different views at the intersection between science and policy. A similar role playing format was used in a public lands management course at the University of Arizona, and students reported that the role playing activities increased their understanding of land management issues, maintained their interest in the subject matter, and enhanced their academic skills (Oberle 2004).

Another benefit to role playing activities is that students, rather than the instructor, are responsible for addressing weaknesses in arguments made by other students. For example, in a course that was recently taught on public land management at the University of Colorado, we conducted a series of “public hearings” on three current public lands issues. The public hearings were modeled after those that federal land management agencies hold in local communities when dealing with highly controversial management decisions. For each public lands issue, the students played three different

roles: 1) public speakers, 2) land managers, and 3) the press. In the first round of presentations, the public speakers made arguments against a decision being made by the land managers. By the next class period, the land managers were responsible for compiling all the concerns expressed by the public speakers and responding to each concern in a group presentation. After the response by the land managers was given, the hearing was opened to questions by “the press.” The group of students that acted as the press was asked to address any weaknesses in the arguments presented by either side during the public hearings. This format is similar to a debate and demonstrates to students that weak arguments will be rapidly countered and subsequently refuted by the “opposition” group.

## Self Evaluation

The self evaluation is a written document in which students reflect on what they have learned and evaluate their performance at the end of the term. This document is not simply a list highlighting a student’s achievements during the term but a polished journal entry reflecting on their growth and vision for the future. Properly executed self evaluations are a truthful assessment of how scholarship and participation can improve in future coursework (McMillan and Hearn 2009). They also provide an opportunity for students to think more broadly about their life goals and reflect upon their progress towards achieving those goals and can be a strong motivational tool for students to guide their own learning (McMillan and Hearn 2009).

In the syllabi that we hand out at the beginning of each class, we provide suggestions for writing self evaluations that follow the basic guidelines outlined by the Evergreen State College Writing Center (<http://www.evergreen.edu/writingcenter/evaluationsself.php>). We recommend that students follow three stages of writing a self evaluation: 1) brainstorming and self reflection, 2) filtering to identify the key ideas and concepts, 3) revision of the initial draft, and 4) evaluation and critical review of the evaluation to make sure that the main points are presented clearly and thoroughly.

Several studies have suggested that some personality types are likely to exaggerate in their self evaluations unless there is external accountability (e.g. Langan et al. 2008), and that the accuracy of self evaluations may be influenced by the academic abilities of the student (Saavedra and Kwun 1993). We use two strategies to encourage honest and accurate self evaluations. First, the self evaluations are factored into the final grade, and the students are told repeatedly that a well-done evaluation is an accurate one. Second, students are required to meet with the instructor for at least 10 minutes to discuss their evaluations, including discrepancies between the instructor’s perception of their performance, their grades, and their evaluation. In these ways we hold students responsible for an accurate, reflective evaluation.

In order to illustrate how a self evaluation is written, we have chosen in several but not all of our courses to write a self evaluation of our own performance as instructors. Writing self evaluations of our teaching performance accomplishes several goals. First, we can demonstrate how to write an evaluation, since many of our students are still confused by the process even after lengthy explanations. And second, we illustrate that even we, as professors, are willing to critique and evaluate our own performance. Our students appreciate the fact that we are able to hold ourselves accountable for our teaching performance and that we are willing to subject ourselves to a similar evaluation. We feel that student self evaluations improve greatly by our willingness to examine our own performance.

## Implementation

We fully understand the demands that most faculty members, especially pre-tenured faculty, have outside of the classroom, such as graduate student mentoring, running a laboratory, and service to our institutions and disciplines. Moreover, there will always – or at least for the foreseeable future- be some institutional limitations to developing novel curricula at research universities. A key question is whether it takes a lot of additional time and effort to transform a standard lecture-based class to one using these novel approaches? We found that there is a transition period but the time commitment is similar and the different approach keeps us, as instructors, more engaged in teaching. Our enthusiasm for giving lectures generally declines during a term, and these activities give us, as well as the students, breaks from lecturing.

However, hard choices must be made in order to put these activities into practice. One of the most important challenges in creating time for these activities is to decide what content will not be covered. Transitioning from a lectured-based course to one that incorporates a range of activities, such as role playing and seminars, requires that the quantity of material covered in the term decrease. For example, to cover all of that material in most textbooks during a term would require covering one to two chapters a week. Such a course would leave no time for other activities. Thus we believe it is critically important to decide on a few main concepts that will be the focus of the course throughout the term, and then use a textbook in support of these efforts. As a result, we may only cover 50-75% of what is offered in the textbook.

Another point that seems inherently obvious, but that instructors should be aware of, is that students may not get excited about these different learning activities. The kinds of methods we are implementing may initially be seen as a distraction or even a nuisance especially when students are balancing the activities required in class with 4 and not uncommonly 5 other courses they would take in an academic term. Indeed, Woods (1994) and Felder and Brent (2010) describe how students asked to take responsibility for their own learning may experience a series of emotional stages including shock, denial and struggle, that are comparable to people who have experienced trauma. Students may even feel they are learning less in classes that incorporate more active learning strategies relative to a lecture based course, when in fact, learning assessments suggest that they actually learned more (Goodwin et al. 1991; Lake 2001). To counter student skepticism to active learning strategies and ease the transition to the final psychological stages characterized by restoration of confidence and ultimately success, we spend a lot of time early in the term thoroughly explaining the goals behind our teaching methods and do this repeatedly throughout the term. In addition, the self evaluation process provides an additional benefit of providing students the time to evaluate the differences they experienced in a class with a substantial number of active learning activities as compared to a lecture based course. Students may not feel that they have learned a lot during a term until they have reflected on their learning in a self evaluation.

## Conclusions

Our central goal is to create a classroom environment in which our students are taking responsibility for their education and performance. We believe that student-led classrooms should and can be just that: student led. Since many of our students have little experience with student led activities there is a period of adjustment early in the term when we are “training” our students to take control of their performance. One of the best ways to do this is to lead by example. We role play and self evaluate along with our students, to let them know that we are willing to ask of ourselves what we are asking of

them. We feel that our activities have encouraged students to take greater personal responsibility for their learning, to connect what they are learning in our classes to other topics and to their personal goals, and, ultimately, to delve more deeply into the subject matter than they otherwise would.

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